Grim sorrow flies, whilst hope her place illumes;
The muse obedient—o'er Atlantic's waste
Her course pursues, (she floats in rapid plumes,)
To guard the youth with ev'ry virtue grac'd.
This done, the Heav'nly messenger expands
Her radiant wings, and bends her flight afar,
To those pure regions, whose seraphic bands
'Gainst vice's votaries wage eternal war.

Bonemain, Sept. 14th, 1812. JUNIUS

DISCOVERIES AND IMPROVEMENTS, IN ARTS, MANUFACTURES, AND AGRICULTURE.

An Account of Bleaching; extracted from the Edinburgh Encyclopædia.

(Concluded from page 403, of our last number.)

THE common operations of bleaching, consist of

Steeping,
Bucking,
Boiling,
Immersion in the oxy-muriatic acid.
Souring, washing, &c.

SECT. I.—*On Steeping.*

In the preparation of yarns for weaving, whether composed of flax or cotton, it is necessary that the weaver employ some gelatinous substance, to give the threads the necessary adhesion to stand the operation of weaving. This substance is commonly made of wheaten flour, boiled in water to the consistence of pap, which is applied to the threads with a brush. This is the principal extraneous matter upon the goods, which it is the business of the bleacher to remove. To accomplish this, the linen, after being properly assorted, are washed in the wash stocks for some hours, in order to free them from loose stuff which may be attached to them. They are then put into a large circular vat, made of fir-deal boards, called technically a kieve, into which they are laid regularly one above another, without being too much compressed. After the goods are disposed in the kieve, it is filled with alkaline ley, at a blood-heat, which already has been used in bucking or boiling former parcels. A piece of wood, in the form of a cross, is then fixed above the goods, in order to keep them below the liquid.

In a few hours, an intestine motion is observable, and an increase of temperature takes place; the liquid swells; bubbles of air rise to the surface; and a thick scum is thrown up. This fermentation continues from twelve to eighteen hours, according to the state of the weather. So soon as it is observed that it has ceased, the goods must be instantly withdrawn from the kieve, and again carried to the wash stocks, or to the dash-wheel, in order to be cleared from the loosened filth. Should the goods be left too long in the steep, they are liable to considerable damage; as, after the acetous fermentation ceases, the putrid fermentation begins, and the coloured matter, in place of being loosened from the goods, is fixed in them; and, at the same time, the dissolution of the vegetable fibre of the cloth is begun, and were they to remain too long in this state, they would absolutely rot. It is, therefore, the bleacher's care to guard against so serious an accident.

SECT. II.—*On Bucking.*

This is one of the most important operations in the bleaching of linen goods. There are several methods whereby this process is carried on, but of these we shall only select two, distinguishing them as the old and new methods of bucking. In the former way, the linens having been steeped in the alkaline ley, as before described, and afterwards well washed, are regularly arranged in a large wooden vat, or kieve; a boiler of sufficient capacity is then filled with caustic alkaline ley, which is heated to the temperature of blood. The boiler is then emptied, by a stop-cock, upon the linens in the kieve, until they are covered with the liquor. After having remained on the cloth for some time, it is run off by a stop-cock at the bottom of the kieve, into an iron-boiler sunk in the ground, from whence it is raised into the boiler by a pump. The heat is now raised to a higher temperature, and the ley again run upon the goods in the kieve; from whence it is returned into the boiler, as before described: and these operations are continued, always increasing the heat, until the alkaline ley is completely saturated with the colouring matter taken from the cloth, which is known by its having acquired a completely offensive smell, and losing its causticity.

When we consider the effects which heated liquids have upon coloured vegetable matter, we shall see the propriety of the temperature of the alkaline ley being gradually increased. Thus, when vegetable substances are hastily plunged into boiling liquids, the colouring matter, in place of being extracted, is by this high temperature fixed into them. It is on this principle which a cook acts in the culinary art, when the green colour of vegetables is intended to be preserved: in place of putting them into water when cold, they are kept back until the water is boiling; because it is well known, that, in the former case, the green colour would be entirely extracted, whereas, when the vegetables are not infused until the water is boiling, the colour is completely preserved, or fixed. On the same principle, when the temperature of the alkaline ley is gradually raised, the extractive and colouring matter is more effectually taken from the cloth; and the case is reversed, when the ley is applied at the boiling temperature, so much so, that linen which has been so unfortunate as to meet with this treatment, can never be brought to a good white.

When the alkaline ley is saturated with colouring matter, it is run off, as unfit for further use in this operation. But were the linens instantly to be taken out of the kieve, and carried to be washed in the dash-wheel while hot, a certain portion of the colouring matter would be again fixed into them, which is extremely difficult to eradicate. In order to prevent this, the most approved bleachers run warm water upon the cloth, so soon as the impure ley is run off; this combines with, and carries off part of the remaining impurities; a stream of water is then allowed to run on the cloth in the kieve, until it comes off almost transparent. The linens are now taken to the wash-stocks, or to the dash-wheel, to be further cleaned, with the greatest safety.

The process of bucking was long carried on in this manner, without any improvement, until Mr John Lourie, introduced an apparatus, admirably calculated for conducting this operation on the large scale, which being in some measure self operative, much labour, as well as a considerable quantity of alkali, is saved

The boiler being filled with caustic alkaline ley, and the linens being pro-

perly arranged in the wooden kieve above it, the handle of the pump is set in motion by the machinery: the ley now flows through the pipe by the working of the pump, and falling on the broad plate of metal, it is spread in a perpetual current on the cloth, while the valve opening inwards admits the ley to run into the boiler. Immediately on the pump being set to work, a fire is put to the boiler, by which the ley being gradually heated, the linens receive the benefit of the regular increase of temperature, and the colouring matter from the cloth is thereby more effectually removed. When the ley begins to boil, the handle of the pump is detached from the machinery of the water wheel, and by the ley being completely confined in the close boiler, it is forced up the pump, and falls in a perpetual stream through the pipe, upon the linens in the kieve.

The efficacy of this manner of conducting the bucking process must be evident at first sight: while the heat is gradually increased, a current of fresh ley is constantly presented to different surfaces of the goods for saturation, thereby rendering it more active in cleansing them. Besides, the manner in which the apparatus is first wrought by the water-wheel, or steam engine, and its self-operating power afterwards, puts it completely out of the power of servants to slight the work, independent of the great saving of alkali, which, in most cases where it has been applied, amounts to from one-fourth to one third of the quantity formerly used.

Sect. iii.—*On Boiling.*

In the bleaching of linen cloth, boiling is only used when the goods are nearly white, with pearl-ashes alone, or with pearl-ashes along with soap, towards the end of the whitening process.* all that is necessary in this operation, is to keep the goods completely under the liquid, so that it may act uniformly upon them. In no case is the boiling carried on in a violent manner, but with a gentle simmering heat. The boilers are made of cast iron, of the common construction, with a large stop-cock at bottom, in order to empty it of the waste ley.

Sect. iv.—*Immersion in the Oxy-muriate of Pot-ash.*

According to the doctrine of modern chemists, the oxy-muriatic acid, in consequence of yielding up its oxygen to the colouring matter of vegetables, thereby deprives them of colour, and by this means they are further prepared for alkaline substances acting upon them, and fitting them for the reception of oxygen in subsequent immersions. We have already described the method of preparing the oxy-muriatic acid with pot-ash at some length, and have now only to remark, that the common way of diluting it for use, is by adding it in sufficient quantity to pure water, until the specific gravity of the mixture is 1005. The linens, after being clean washed, are steeped in it for twelve hours, then drained, and washed for being further bucked or boiled.

Sect. v.—*On Souring.*

Souring is in general the last or finishing process in bleaching, as afterwards the linens are only further washed in spring water, in order to their being blued and made up for the market.

In preparing the sour, into a large fir tub, lined with lead, as much sul-

* Our readers conversant in bleaching will perceive the difference between the Scotch mode of bucking, and the practice more general in Ireland, of boiling, from the commencement of the operations of bleaching. B.M.M.

phuric acid is added to water as will give it the acidity of strong vinegar. The acid and water must be well mixed together before immersing the linens, which are generally steeped in it for twelve hours, then drained, and washed in pure water. The operation of washing must be paid particular attention to after this process; were any of the acid to remain in the goods, and to be dried into them, they would infallibly rot, although the acid has no such effect upon them while they are kept wet.

What effect souring has in bleaching, neither the practical bleacher nor the chemist have attempted to determine. It is certain, that from frequent use, it completely loses its acidity, and remains an inert substance, similar to a neutral salt. Some suppose that it is saturated with the remaining alkali which has not been completely washed from the goods; with iron, which is said to be a component part of all vegetable substances; or with earth, which is likewise said to be contained in them. Whatever may be in these conjectures, it is certain, that when linens are soured about the middle of the bleaching process, it has a considerable effect in hastening forward the goods to a complete white, and, in consequence, early souring has been adopted by the best practical bleachers.

Having made these preliminary observations with regard to the method of applying the various articles used in bleaching linen cloth, we shall now bring the whole into one point of view, by detailing the connection of these processes, as carried on at a bleachfield which has uniformly been successful in returning the cloth of a good white, and otherwise giving satisfaction to their employers; and we shall only previously remark, that we by no means hold it up as the best process which may be employed; as every experienced bleacher knows, that processes must be varied, not only according to existing circumstances, but also according to the nature of the linens operated upon.

In order to avoid repetition, where washing is mentioned, it must always be understood that the linen is taken to the wash-stocks, or dash-wheel, and washed well in them for some hours. This part of the work can never be overdone; and on its being properly executed between every part of the bucking, boiling, steeping in the oxy-muriatic acid, and souring, not a little of the sucess of bleaching depends. By exposure is meant, that the linen cloth is taken and spread upon the bleach-green for four, six, or eight days, according as the routine of business calls for the return of the cloth, in order to undergo further operations.

A parcel of goods consists of 360 pieces of those linens which are called Britannias. Each piece is 35 yards long, and they weigh on an average 10 pounds each: the weight of the parcel is, in consequence, about 3600 pounds avoirdupois weight. The linens are first washed, and then steeped in waste alkaline ley, as formerly described under these processes; they then undergo the following operations:

1st, Bucked with 60 lb pearl-ashes, washed, exposed on the field.
2d, Ditto . . . 80 . . . do. . . . do. . . do. . . . . do.
3d, Ditto . . . 90 . pot-ashes, . do. . . do. . . . . do.
4th, Ditto . . . 80 . . . do. . . . do. . . do. . . . . do.
5th, Ditto . . . 80 . . . do. . . . do. . . do. . . . . do.
6th, Ditto . . . 50 . . . do. . . . do. . . do. . . . . do.
7th, Ditto . . . 70 . . . do. . . . do . . do. . . . . do.
8th, Ditto . . . 70 . . . do. . . . do. . . do. . . . . do.

9th, Soured one night in dilute sulphuric acid, washed.
10th, Bucked with 50 lb pearl-ashes, washed, exposed on the field.
11th, Immersed in the oxy-muriate of pot-ash 12 hours.
12th, Boiled with 30lb pearl-ashes, washed, exposed on the field.
13th, Ditto . . . 30 . . . do. . . . . do. . . do. . . . . do.
14th, Soured, washed.

The linens are then taken to the rubbing-board, and well rubbed with a strong lather of black soap, after which they are well washed through pure spring water. At this period they are carefully examined, and those which are fully bleached are laid aside to be blued and made up for the market; while those which are not fully white, are returned to be boiled and steeped in the oxy-muriate of pot-ash, and soured, until they are fully white.

By the above process 690 pounds weight of alkali is taken to bleach 369 pieces of linen, each piece consisting of 35 yards in length; so that the expenditure of alkali would be somewhat less than 2lb for each piece, were it not that some part of the linens are not fully whitened, as above noted. Two pounds of alkali may therefore be stated as the average quantity employed for bleaching each piece of goods.

The method of bleaching linens in Ireland is similar to the foregoing; any alteration in the process depending on the judgment of the bleacher in increasing or diminishing the quantity of alkali used. But it is common at most bleachfields to steep the linens in the oxy-muriate of pot-ash, or lime, at an early stage of the process, or after the goods have undergone the fifth or sixth operation of bucking. By this means, those parts of the flax which are most difficult to bleach are more easily acted upon by the alkali; and, as before noticed, souring early in weak diluted sulphuric acid assists greatly in forwarding the whitening of the linens. Mr. Grimshaw, calico printer, near Belfast, was the first who recommended early souring, which has since been very generally adopted.

Bleaching for Calico Printing.

In bleaching linen and cotton cloth for the purpose of being stained with different colours, in the process of calico printing, a pure white is not so much sought for, as that the goods are what is technically called well rooted; that is, that the colouring matter and vegetable oil is fully exfully extracted from them. This is attained chiefly by the linens being bucked and boiled in a solution of alkali, rendered moderately caustic by quicklime, in order to preserve the fabric of the cloth from being too much reduced. The alkaline solution must be well settled, and transparent as water; because, if the lime remains either in solution or suspension in the smallest proportion, it is apt to be precipitated into the fabric of the cloth, and destroy the purity of those parts intended to be white. Linen cloth requires to be bucked and boiled from ten to twelve times in the alkaline solution; being well washed and exposed on the bleachgreen between each operation. It is soured at the end of the sixth boiling; and again soured at the end of this process, when the goods are supposed fully bleached for printing.

To ascertain whether the cloth is fit for printing, a small stripe is torn from the end of one of the pieces, and printed with one of the mordants used in the fixing of the dye. After that the mordant has remained a sufficient time in the cloth, it is

rinsed in pure water to carry off the superfluous parts of the mordant, and then immersed into a copper pan in cold water, which contains a little madder; the heat is gradually increased, while the cloth is alternately raised and lowered by a bit of stick in the decoction of madder, until the colour is dyed to the shade required. At this period, if the cloth is properly bleached, the place stained with the mordant will alone have attracted the colouring matter of the madder; while the rest of the rag remains white. But should the part intended for white be stained a dirty light red, the cloth is not fully bleached, and it must again be boiled in the solution of alkali.

Cotton cloth intended for calico printing is more easily bleached than linen-cloth; five, or at most six, boilings in the alkaline solution, being all that is requisite for making a good white. One pound of pot-ashes is fully sufficient to bleach a piece of calico of 21 square yards. This gives about three ounces of potash to each piece for every time they are boiled. Between every part of the boiling process, the calicos are washed and exposed on the bleach-green, the same as linen-cloth; and soured, at the end of the process, in the same manner. In order to ascertain whether they are fully bleached for printing, the same method is followed as that which is already described for the trial of linen-cloth.

In bleaching both kinds for printing, it is not customary to immerse them in the oxy-muriatic solutions; except in the winter months, when a good white is not so easily obtained, by the action of the sun and air. Neither are the goods watered artificially when spread on the bleach-green; but they are (after being well washed) allowed to lie exposed to all the vicissitudes of the season, until the common routine of business calls for their return to undergo farther operations. This process is commonly called dry-bleaching, in contradistinction to that in which the goods are artificially wetted when exposed on the field.

After linen or cotton-cloth is printed and dyed, a certain dulness of colour attaches itself to the parts intended to remain white; arising partly from the imperfection of the bleaching, but more frequently from a part of the mordant, which has been printed on the cloth, being loosened by the increased temperature of the water bath. This unites with the decoction of madder or other colouring matter used in the bath, and is precipitated on the parts intended to remain a pure white. To remove this partial stain in an easy manner, without long exposure upon the bleachgreen, has long been much wanted by calico printers.

In order to attain this, various methods have been resorted to without effect, arising partly from the imperfection of the substances employed. Steeping printed goods after being dyed, in the oxy-muriate of lime, not only changes all the colours, and renders them of a duller hue, but also particles of the lime attach themselves so intimately to the cloth, that it acts as a discharge, and effaces the colours altogether. Although a dilute solution of the oxy-muriate of potash does not act in so severe a manner as the oxy-muriate of lime, yet it operates strongly as an alterative to most colours; changing the red colour to pink, and the purple and lilac are turned to blueish shades of the same colour; besides, the action of the alkali scourges the whole colours, by reducing their intensity and brilliancy. In consequence of these defects, both these substances are unfit for producing a good white on

printed goods; without, at the same time, acting as an alterative, in completely changing the shade of colour wanted.

In searching for a substance which possesses none of these pernicious qualities, we have found, that the oxy-muriate of magnesia in every respect answers in the most complete manner, not only for clearing the white ground of the goods, but also in preserving the colours of the same shade which they were originally.

Of all the earths which are partially soluble in water, magnesia possesses the property of changing colours least; the alteration made by it on paper stained with litmus, being scarcely perceptible. It is, therefore, peculiarly fitted, when united with oxygen, for the purpose of clearing the stain from the white of printed goods.

In making this preparation, the magnesian earth must be previously broken in water, as fine as possible, in the manner of starch. It is then introduced into the receiver of the apparatus for making the oxy-muriatic acid. Into the retort one part of good manganese is introduced, on which is poured two parts of muriatic acid, of the specific gravity of 1200, diluted with its bulk of water; the distillation instantly commences, and the magnesia is dissolved by the muriatic acid. In order to keep the magnesia in suspension, it is necessary to agitate the liquor in the receiver occasionally by a staff similar to a churn-staff, which is placed in the receiver, the handle coming up through the centre of the cover.

When the magnesia is dissolved, and the impurities which it may contain have subsided, it is drawn off for use. For this purpose, a clean copper is filled with pure water, and the heat is raised to about 160 or 170 degrees of Fahrenheit. So much of the oxy-muriate of magnesia is then added, as will give to the water in the copper a sensible taste of the salt. As soon as it is introduced, the whole must be quickly mixed together with a clean broom. The printed goods, having been previously slightly braned, are then quickly run over the wince into the copper; continuing to run them over the wince until the white is sufficiently clear. This operation takes only a few minutes. The goods are then carried to be streamed in pure water, to prevent the further action of the oxygen on the colours. By the addition of a little more of the oxy-muriate of magnesia, fresh parcels of goods may be entered into the copper for clearing, and the process may be thereby continued for a whole day; after which the contents are run off from the boiler.

On Bleaching Muslin.

In the bleaching of the coarser kinds of muslin, such as the fabric of goods called Jaconet, after they have been steeped and washed, they are first boiled in a weak solution of pot and pearl ashes; after being again washed, they are twice boiled in soap alone, and then soured in very dilute sulphuric acid. Being washed from the sour, they are again boiled in soap, washed, and then immersed in the oxy-muriate of potash. The boiling in soap, and steeping in the oxy-muriate, is now repeated, until the muslin is a pure white. They are then soured, and washed in pure spring water.

In bleaching the finer fabrics of muslin, such as those kinds called Mull Mull and Book, nearly the same process is followed as the above for bleaching of Jaconet; only that, on account of the fineness of the fabric, no pearl ashes are used, but soap alone. Otherwise they are treated in the same manner, in being alternately

washed, boiled, and steeped in the oxy-muriate of potash; and when fully white, they are soured in dilute sulphuric acid.

In the bleaching of cotton cloth, where fixed colours* are previously dyed in the yarn before it is wove into cloth, great care is necessary. Before it was customary to introduce caustic alkali into the receiver of the apparatus for making the oxy-muriate of potash, the most complete uncertainty occurred with the bleacher, in his attempt to bleach cotton goods wherein the most fixed colours were wove. Sometimes the colours were in tolerable preservation when the oxy-muriatic acid was used in moderation; at other times, the colours were almost entirely extracted from this acid being used too strong. At last, it was discovered, that when a considerable quantity of the alkali was introduced into the receiver, for the neutralizing of the oxy-muriatic acid, that the fixed or permanent colours, which were immersed into it, were by no means injured. On this principle, cotton goods of the kind called Pulicates, into which fixed colours are wove, and which have thoroughly to undergo the whole process of bleaching, the colours are more brilliant than in those goods, of the same kind, which are wove along with the yarns that have been previously bleached.

The common process of bleaching pulicates, into which permanent colours are wove, is, to wash the dressing or starch well out in cold water. To boil them gently in soap, and after again washing, to immerse them in a moderately strong solution of the oxymuriate of potash; and this process is followed until the white is good: they are then soured in dilute sulphuric acid. If the goods are attended to in a proper manner, the colours, in place of being impaired, will be found greatly improved, and to have acquired a delicacy of tint which no other process can impart to them.

Pulicates, or ginghams, which have been wove along with yarn which has been previously bleached, are first freed by washing from the starch or dressing: they are then washed, or slightly boiled with soap. After which, they are completely rinsed in pure spring water, and then soured.

Besides these common processes for bleaching, another has been lately introduced with great success, by Mr. John Turnbull of Bonhill-place, in Dunbartonshire, for which a patent was granted to him.

This method of bleaching consists of immersing the cotton or linen goods in a pretty strong solution of caustic alkali, and afterwards exposing them to the action of steam in a close vessel.

The receiver is made of fir-deal boards firmly hooped, into which the cloth is laid loosely on the iron grating. Iron hesps are fixed to the side of the receiver, into which another hesp of iron, containing a screw is placed. This is moveable, and folds over by a joint, to make fast the cast iron cover on the mouth of the tub or receiver: the joining of the lid is closely luted by plated rope being nailed to the mouth of the tub. The iron cover is put on its place, or removed at pleasure, by the hook of a crane being put into the ring, fixed in the centre of the lid. A hole is

* By fixed colours are here meant, those which resist the action of the alkalis in an eminent degree, with proper treatment. The colours usually denominated fixed, on cotton, are the Turkey or Adrianople red, and its compounds of lilac and purple, by the addition of iron bases; various shades of blue from indigo, together with buff and gold colour, tinged with the oxides of iron.

pierced through the cover, into which a wooden pin is thurst, the use of which is to know when the steam is of sufficient strength.

The cotton or linen goods having been previously cleaned by steeping and washing, are, after being well drained, steeped in a solution of caustic alkali of the specified gravity of 1020. After the superfluous alkaline ley has been drained from them, they are arranged on the grating in the receiver. The cover is then placed on the vessel, and firmly screwed down; and the steam is admitted by turning the stopcock, of the pipe which communicates with a steam boiler of the common construction.

When the steam is admitted, the action of the alkali is increased by the heat, so as completely to dissolve the colouring matter of the cloth. The steaming is continued for some hours, after which the cloth is removed to the wash stocks, or dash wheel, in order to be cleansed: they are again immersed in the solution of alkali, and steamed in the receiver until they are sufficiently white; after which they are soured and washed as in common bleaching. This process of whitening linen or cotton cloth, may also be forwarded by the assistance of the oxymuriatic acid, at proper intervals.

By this method of bleaching, a considerable saving of alkali is gained, as the whole is completely saturated with the colouring matter of the cloth. Nine, or at most ten steeps in the alkali, with alternate exposure to the action of the steam bath, being sufficient to bleach linen cloth effectually: Five steeps, with exposure to the steam, is sufficient for cotton cloth.

Having thus given a succinct account of the various operations of bleaching, we shall close this article, by making such observations as seem naturally to arise from the subject.

The first inquiry which presents itself is, what are the substances with which linen and cotton cloth is coloured? This is shown by Mr. Kirwan in his excellent memoir on this subject, contained in the *Irish Transactions* for 1789.

He precipitated, by means of muriatic acid, the colouring matter from an alkaline ley, saturated with the extract from linen yarn, and found it to possess the following properties. When allowed to dry on a filter, it assumed a dark green colour, and felt clammy like moist clay.

"I took," says he, "a small portion of it, and added to it 60 times its weight of boiling water; but not a particle of it was dissolved. The remainder I dried on a sand heat; it then assumed a shining black colour; became more brittle; but internally remained of a greenish yellow, and weighed an ounce and a half.

"By treating eight quarts more of the ley in the same manner, I obtained a further quantity of greenish deposit, on which I made the following experiments.

"1. Having digested a portion of it in rectified spirits of wine, it communicated to it a reddish hue, and was in a great measure dissolved; but, by the addition of distilled water, the solution became milky, and a white deposit was gradually formed: the black matter dissolved in the same manner.

"2. Neither the green nor the black matter was soluble in spirit of turpentine or linseed oil, by a continued long digestion.

"3. The black matter being placed on a red-hot iron, burned with a yellow flame and black smoke, leaving a coaly residuum.

"4. The green matter being put into the vitriolic, muriatic, and nitrous acids, communicated a brownish tinge to the two former, and a greenish to the latter; but did not seem at all diminished.

"Hence it appears, that the matter extracted from linen yarn by alkalis, is a peculiar sort of resin, different from pure resins only by its insolubility in essential oils, and in this respect resembling lacs. I now proceeded to examine the powers of the different alkalies on this substance. Eight grains of it being digested in a solution of crystallized mineral alkali, saturated in the temperature of 62°, instantly communicated to the solution a dark brown colour; two measures, (each of which would contain 11 pennyweights of water,) did not entirely dissolve this substance. Two measures of the mild vegetable alkali dissolved the whole.

"One measure of caustic mineral alkali, whose specific gravity was 1.053, dissolved nearly the whole, leaving only a white residuum.

"One measure of caustic vegetable alkali, whose specific gravity was 1.039, dissolved the whole.

"One measure of liver of sulphur, whose specific gravity was 1.170, dissolved the whole.

"One measure of caustic volatile alkali dissolved also a portion of this matter."

From the foregoing observations of Mr. Kirwan, it is evident, that the lac or resinous matter which is extracted by the alkalies from linen yarn, is in proportion to their capacity for acting upon this colouring matter; and that the vegetable alkali, whether in its mild or the caustic state, is the best solvent of this matter.

We here take the opportunity of remarking, that at most bleachfields, they are extremely defective in rendering the alkaline leys properly caustic by quicklime. Into a solution of about four hundred weight of potashes, dissolved in about 300 gallons of water, we have frequently seen only 40 or 50 pounds of quicklime used; and so imperfectly was it applied, as only to be agitated by a rake for five or ten minutes in the cold solution. Quicklime having the power of precipitating the uncombined charcoal, and other impurities, the operator was satisfied, that he had given to the alkaline ley its full powers; but this is a mistake. When the alkaline ley is rendered completely caustic, nothing more is necessary but to reduce the quantity of the ley used. By this means the linen cloth will not be too severely acted upon.

This process is now carried into effect by the more intelligent bleachers; and at least one-third of the alkali they formerly used is thus saved.

In order to render the alkali sufficiently caustic, the following process may be followed:—To two parts of potash, dissolved in hot water, add one part of fresh slaked lime, finely pulverised. After the lime is added, make the mixture boil; taking care, that it is agitated by an iron rake, to keep it from subsiding and fixing on the bottom of the boiler. After it boils, the agitation will be sufficient to keep the lime in suspension; the ebullition may be continued for two hours, and the lime allowed to subside: the clear liquor may then be run off for use, and the precipitated lime well washed with water, until it loses the alkaline taste. The washings may be kept for making fresh alkaline solutions.

On examining the quicklime which has been used, it will now be found in the state of a carbonate; having, by its superior affinity for carbonic acid, deprived the potash of

this principle, which will consequently be found nearly in the caustic state.

From the experiments of Mr. Kirwan, as narrated above, it will be seen, that the power of caustic potash, in dissolving the colouring and resinous matter contained in the linen yarn, is at least double the power which it possesses when in the mild or carbonated state. This agrees also, with the experience of every well-informed bleacher. Hence at least one-half of the alkali will be sufficient when used in the caustic state, when put in opposition to the quantity which will be required when in the mild state.

As having the alkaline ley nearly of the same specific gravity, is of considerable importance to the bleacher, the hydrometer is generally used for ascertaining its strength. Formerly this useful instrument was constructed on no fixed principle, so that when one of them was broken, another could not be procured made to the same scale. The difficulty is now overcome, and the instrument may be had from Mr. William Tweedale of Glasgow, with invariably the same scale. The principle on which he constructs these hydrometers, is, that the scale commences at 1, and every degree indicates .005 of specific gravity. Hence, supposing the alkaline ley to indicate 20 degrees on the scale of the hydrometer, its specific gravity would be $1. \times 20 \times 005 = 1.100$, the specific gravity of water being unity. A complete series of these, from No. 1 to 6, indicate the specific gravity of fluids from distilled water as 0, to sulphuric acid 2., the heaviest liquid known. These instruments are now used in most parts of the united kingdom.

From the increase and variable price of potash, and the dependence of Great Britain on foreign nations for this necessary article, it is of importance that the expenditure of it be reduced as much as possible. Accordingly, various attempts have been made to recover the alkali from the strongest waste ley, which had been used in the boiling of linen cloth. But the methods which have been followed for this purpose, have in general been given up, on account of the great expenditure of fuel necessary for evaporating the ley to a proper consistence for procuring the alkali. We shall, therefore, take no notice of the methods which have been unsuccessful; but mention one, which to us appears practicable, and which those who are interested may use with safety. It is scarcely necessary to observe, that the alkaline ley must be supposed to be of such value, as to render the recovery of the potash an object to the bleacher.

At some extensive chemical manufactories, where it is necessary to evaporate very large quantities of liquid to a given strength, at a small expense; in place of evaporating these solutions in iron or leaden boilers, it is found more economical to construct what are called stone boilers for this purpose. These are nothing more than large oblong chambers, the side walls of which are about two feet high, built into the ground to prevent them giving way. The outside of the wall is well rammed with tempered clay-puddle, to prevent leakage. An arch of brick is then thrown over between the walls, which is covered with mortar to retain the heat. Proper openings are, at the same time, left to examine the state of the liquid: these are covered with a plate of iron. At one end of the chamber, a furnace of a sufficient capacity is built, having a breast-work interposed between it and the liquid, over which the flame plays. At the other

end of the chamber, a vent of sufficient height is built to carry off the smoke. The fire being lighted, the flame plays along the surface of the liquid, which by this means is evaporated. Some of these stone boilers are so capacious, as to contain 10,000 gallons.

In evaporating waste ley for the recovery of the alkali, all that is necessary, after it has been evaporated to the consistence of tar, is, to carry it to a reverberatory furnace, of a proper construction, where, the mass being dried, it takes fire, and burns with a vivid flame. So soon as the heat is sufficiently strong, the alkali melts, and forms a liquid mass, which is run out of the surface, by a taphole at the side of the furnace, into an old boiler which has been previously heated, to prevent the melted mass from sparking up, and burning the workman employed.

On examining the alkali thus procured, it will be found in a state of greater purity than when first used; because, in the incineration, every particle of the resinous and colouring matter is completely consumed, and the carbonaceous matter which it had extracted out of the cloth, reduces any sulphate of pot-ash, which the purest imported alkali always contains, to the state of a carbonate. Hence, when the recovered alkali is dissolved and rendered caustic by quicklime, its effects in bleaching will be found equal, if not superior, to the first sort of pot-ashes.

Another method by which pot-ash, when used in boiling cotton goods, may be freed from a large proportion of the impurity which it contains, is, by the application of quicklime to the waste ley in the liquid state.

If, to a solution of pot-ash, saturated with the coloured extract from cotton cloth, a proper quantity of quicklime be added, and the mixture be well agitated, a decomposition takes place, and the colouring matter is precipitated.

The extract from linen cloth, containing a greater proportion of resinous matter, is not so easily decomposed; yet, if a small proportion of fresh precipitated earth of alum be added to it along with the lime, and the mixture be well agitated, a decomposition is effected.

The impure alkaline solution is rendered caustic, and becomes transparent, although it does not entirely separate from the lac or resinous principle which it had extracted from the linen cloth. In both cases, it separates best from the extractive matter when the solution is cold; and the lower the temperature so much the better.

On account of the comparatively high price of soda, it has hitherto been very little used in bleaching. From the experiments of Mr. Kirwan, already mentioned, it will be seen, that the power of soda, as a detergent, is little inferior to pot-ash. A large quantity of barilla, an impure mineral alkali, is imported into the British islands; a considerable proportion of which was, until very lately, used by the bleachers in Ireland, who, from habit, gave it it a preference to pot-ashes. So late as the year 1800, the quantity of barilla imported was..... 175,629 cwt.
In 1802,..... 151,796
In 1800, the quantity of pot-ashes imported was..... 135,400
In 1802, the quantity was only..... 48,054

Barilla being, as well as pot-ashes, a foreign product, it is a matter of no small importance to know, whether we can be supplied with alkali, of home manufacture, at a cheap rate. We do not hesitate to say, that in a very short period, it will be completely in our power.

It is well known to every chemist, that common salt contains the mineral alkali, in the proportion of 53 parts in 100. Could the government of this country be induced to allow the soda manufacturer the free use of this salt, or of sea water, under proper restrictions, we venture to predict, that Great Britain and Ireland would soon render themselves independent of foreign nations for barilla, as well as of a large proportion of the pot and pearl ashes which are used.

The manufacture of soda, of an excellent quality, has already made rapid advances, even under the present restrictions, at London, Newcastle, and Glasgow. At the latter place, and its neighbourhood, no less a quantity than 500 tons is manufactured annually; and large establishments are daily forming for increasing this quantity. It is much to be regretted, that the manufacture of this article, which is of so much consequence to bleaching, dyeing, the manufactures of glass and soap, as well as to many other important branches of commerce, should be shackled by absurd and impolitic restrictions.

In addition to this copious account of bleaching, we are permitted by the Belfast Foundry Company to insert the annexed plate of a new manner of setting furnaces which they have recommended. From practical experience it has been found that by this mode very large savings may be made in the consumption of fuel. As in every improvement many obstacles occur, from the obstinacy of workmen, it will be necessary for the proprietors of bleachgreens to give attention themselves in the first carrying of this plan of setting furnaces into execution, so that the just principles of scientific knowledge may triumph over the obstacles which ignorance and presumption so frequently throw in the way of improvement.

LIST OF NEW PUBLICATIONS.

BOTANY.

OUTLINE of Botany; or, an easy Introduction to the Science; by Dr. Thornton, 5s.

BIOGRAPHY.

Memoirs of the late Philip Melville, Esq., Lieutenant Governor of Pendennis Castle, Cornwall, 10s. 6d.

DRAMA.

The Æthiop; or the Child of the Desert; a Romantic Play, 2s. 6d.

The Renegade; an Historical Drama, 2s. 6d.

EDUCATION.

The Sunday School Repository; or Teacher's Magazine; to be continued quarterly; No. I., 1s.

The Son of Genius; a Tale for the use of Youth, 5s.

GEOGRAPHY AND TOPOGRAPHY.

Sketches of the Sikhs; a singular Nation who inhabit the Provinces of the Penjah, situate between the rivers Jumma and Indus; by Lieutenant Colonel Malcolm, 8s. 6d.

The Lowestoft Guide; containing a descriptive Account of Lowestoft and its Environs, 7s. 6d.

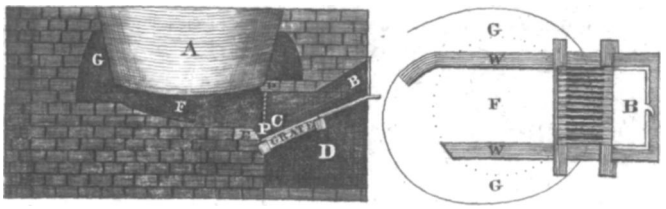
HISTORY.

A Chronological Retrospect; or, Memoirs of the principal Events of Mahomedan History; by Major Price. Vol. II. £.2 10s.

JURISPRUDENCE.

A Treatise on the British Constitution; by J. Marshall, 7s.

A digested Abridgment, and comparative View of the Statute Law in England and



DESCRIPTION OF ANNEXED ENGRAVING.

A—Represents a Boiler, 6 feet in diameter, 2 feet 11 inches deep, set in Masonry.

B—The Furnace Mouth, 3 feet wide, 18 inches deep.

C—The Grate, 3 feet wide 21 inches long.

D—The Ash Pit, 2 feet high, or more, if convenient.

E—A Fire Block across, and set 8 inches higher than the Grate.

F—Bottom Flue, 16 inches high in front, and 8 inches at back.

G—The Side Flue, 8 inches lower than the Boiler, 14 inches wide at bottom, and closed within 9 inches of the lip of Boiler.

The Grate to have the same inclination downwards as the Furnace Mouth; to be arched over with Fire Brick, and the further end of the Grate to be in a plumb line with the side of the Boiler, as shewn by P P.

The Boiler placed on two walls parallel to each other, the width of the Grate asunder, as represented in the platform W W.

The Vent at the back to be the width of the Grate, with a Tongue in the centre.

It is recommended when the Boiler is to be emptied, that the Fire in the Grate be drawn to the Furnace Mouth B, which will not only prove saving of Fuel, but also prevent the risk of breaking the Boiler.